# SIMULATED SAMPLING DISTRIBUTION OF PRICE INDEX NUMBERS

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# Abstract

Index numbers represent change over two different situations. They give an indication of the scenario of the economic pressure related to market situations. The sampling distribution is helpful in explaining the variability of estimates due to sampling. This paper presents an examination of sampling distribution of price index numbers. Graphical plots of various price indices showing the concentration of index estimates around the expected value are included. Several different weighted aggregate price indices are discussed in detail in the form of sampling distributions using numerical support. A comparison among them is made using simulation method and some useful conclusions related to moments are also drawn.

**Keywords :** Index Number, Sampling Distribution, Prices, Quantity, SRSWOR, Raw Moments and Central Moments.

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## 1.0 Introduction:

Index numbers are indicators of the average change in a group of related variables over varying time, space or situations. They are referred to as a measure of change, a device to measure change or a series representing the process of change. Most of the time they are helpful in providing framework for decision making and to forecast future of economy. According to Croxton and Cowden (1967) Index numbers can be classified into following three categories: (**a)** Price Index Number (**b)** Quantity Index Number and (**c)** Value Index Number. More elaborative properties and applications about indices are described in Dubois (1964).

Further, Gupta et.al. (2004) , Dasgupta (2004), and Kotwal and Shinde (2005) have taken into consideration the probability distributions with their relative properties. A limitation of price indices is that their calculation, for all practical purposes, are based on single sample data. If this data varies, the index computation changes accordingly. Therefore, it is important to consider the sampling distributions of these price indices. This paper gives emphasis only on price index number with different formulae, and database sampling distribution is derived to examine the moment properties.

## 2.0 Sample based simulation scheme:

Following Ahmed et. al. (2006) a simulation scheme for sampling distribution of price index number is describe as under;

**Step - I:** Draw a random sample of size n by Simple Random Sampling without Replacement SRSWOR.

**Step -II:** Calculate price index numbers using different methods like (Laspayre's, Paasche's, Marshall-Edgeworth, Dorbish-Bowley's, Fisher's etc.) on each sample.

**Step- III:** Compare these values over a large number of samples.

**Step-IV :** Tabulate the value using class interval and frequencies. Convert frequencies into probabilities by $p_i = \left( \frac{f_i}{\sum f_i} \right)$.

**Step- V:** Draw the curve between the class intervals and probability frequencies.

**Step VI:** Observe the tendency of the curve and compute moments.

## 3.0 Price Index Formulae Used:

As per Croxton and Cowden (1967), and Dubois (1964) different price indices are:

### 3.1 - Laspayre's Price Index Number:

Let $P_0$ be the price of the base year, $P_1$ be the price of the current year, $Q_0$ be the quantity of the base year, $Q_1$ be the quantity of the current year, then

$$P_{o1}^{L} = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \text{ X } 100$$

### 3.2 - Paasche's Price Index Number:

$$P_{o1}^{P} = \frac{\sum P_1 Q_1}{\sum P_0 Q_1} \text{ X } 100$$

### 3.3 - Dorbish - Bowley's Price Index Number:

$$P_{o1}^{D} = \frac{1}{2}\left[\frac{\sum P_1 Q_0}{\sum P_0 Q_0} + \frac{\sum P_1 Q_1}{\sum P_0 Q_1}\right] \text{ X } 100$$

### 3.4 – Fisher Price Index Number:

$$P_{o1}^{F} = \left[\frac{\sum P_1 Q_0}{\sum P_0 Q_0} X \frac{\sum P_1 Q_1}{\sum P_0 Q_1}\right] \text{ X } 100$$

## 4.0 Empirical Study:

The data of 15 commodities are taken and the prices and quantities of base and current year are given and respective values for different formulas of Laspayre's, Paasche's Fisher's and Dorbish and Bowley's are calculated. A sample of 97 units with 7 commodities together is drawn for which the details are provided in tables 4.1 and 4.2. The frequency distribution is prepared and the details related to it are appended in table 4.3.

**Table 4.1 : List of 15 commodities are taken and the details are as under :**

| S. No | Prices of Base And Current Year | | Quantities of Base And Current Year | | Product of Prices And Quantity of Base Year | Product of Prices of Base And Quantity of Current Year | Product of Prices of Current And Quantity of Base Year | Product of Prices And Quantity of Current Year |
|---|---|---|---|---|---|---|---|---|
| | $P_0$ | $P_1$ | $Q_0$ | $Q_1$ | $P_0Q_0$ | $P_0Q_1$ | $P_1Q_0$ | $P_1Q_1$ |
| 1 | 4 | 8 | 10 | 15 | 40 | 60 | 80 | 120 |
| 2 | 1.5 | 20 | 2 | 3 | 3 | 4.5 | 40 | 60 |
| 3 | 11 | 16 | 15 | 20 | 165 | 220 | 240 | 320 |
| 4 | 2 | 2.5 | 400 | 450 | 800 | 900 | 1000 | 1125 |
| 5 | 5 | 4 | 300 | 400 | 1500 | 2000 | 1200 | 1600 |
| 6 | 10 | 12 | 126 | 240 | 1260 | 2400 | 1512 | 2880 |
| 7 | 8 | 6.5 | 200 | 250 | 1600 | 2000 | 1300 | 1625 |
| 8 | 0.9 | 1.6 | 10 | 50 | 9 | 45 | 16 | 80 |
| 9 | 1.35 | 2.5 | 110 | 60 | 148.5 | 81 | 275 | 150 |
| 10 | 3.2 | 4.4 | 40 | 100 | 128 | 320 | 176 | 440 |
| 11 | 2.12 | 3.15 | 16 | 12 | 33.92 | 25.44 | 50.4 | 37.8 |
| 12 | 5 | 6 | 10 | 15 | 50 | 75 | 60 | 90 |
| 13 | 1.75 | 1.9 | 35 | 41 | 61.25 | 71.75 | 66.5 | 77.9 |
| 14 | 6 | 4 | 15 | 30 | 90 | 180 | 60 | 120 |
| 15 | 1.55 | 1.7 | 14 | 20 | 21.7 | 31 | 23.8 | 34 |

**TABLE 4.2 – Total 97 Samples drawn each of 7 commodities from the list of 15 commodities.**

| Sr. No. | Samples | $P_0Q_0$ | $P_0Q_1$ | $P_1Q_0$ | $P_1Q_1$ | Laspayre's | Paasche's | Fisher's | Dorbish & Bowley's |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 to 7 | 5368 | 7584.5 | 5372 | 7730 | 100.07 | 101.92 | 100.99 | 101.00 |
| 2 | 2 to 8 | 5337 | 7569.5 | 5308 | 7690 | 99.46 | 101.59 | 100.52 | 100.52 |
| 3 | 3 to 9 | 5482.5 | 7646 | 5543 | 7780 | 101.10 | 101.75 | 101.43 | 101.43 |
| 4 | 1,2,4,7,9,11,13 | 2686.67 | 3142.69 | 2811.9 | 3195.7 | 104.66 | 101.69 | 103.16 | 103.17 |
| 5 | 1 to 6 and 8 | 3777 | 5629.5 | 4088 | 6185 | 108.23 | 109.87 | 109.05 | 109.05 |
| 6 | 1 to 6 and 9 | 3916.5 | 5665.5 | 4347 | 6255 | 110.99 | 110.41 | 110.70 | 110.70 |
| 7 | 1 to 6 and 10 | 3896 | 5904.5 | 4248 | 6545 | 109.03 | 110.85 | 109.94 | 109.94 |
| 8 | 1 to 6 and 11 | 3801.92 | 5609.94 | 4122.4 | 6142.8 | 108.43 | 109.50 | 108.96 | 108.96 |
| 9 | 1to 6 and 12 | 3818 | 5659.5 | 4132 | 6195 | 108.22 | 109.46 | 108.84 | 108.84 |
| 10 | 1 to 6 and 13 | 3829.25 | 5656.25 | 4138.5 | 6182.9 | 108.08 | 109.31 | 108.69 | 108.69 |
| 11 | 1 to 6 and 14 | 3858 | 5764.5 | 4132 | 6225 | 107.10 | 107.99 | 107.54 | 107.55 |
| 12 | 1 to 6 and 15 | 3789.7 | 5615.5 | 4095.8 | 6139 | 108.08 | 109.32 | 108.70 | 108.70 |
| 13 | 2 to 7 & 9 | 5476.5 | 7605.5 | 5567 | 7760 | 101.65 | 102.03 | 101.84 | 101.84 |
| 14 | 2 to 7 &10 | 5456 | 7844.5 | 5468 | 8050 | 100.22 | 102.62 | 101.41 | 101.42 |
| 15 | 2 to 7 &11 | 5361.92 | 7549.94 | 5342.4 | 7647.8 | 99.64 | 101.30 | 100.46 | 100.47 |
| 16 | 2 to 7 &12 | 5378 | 7599.5 | 5352 | 7700 | 99.52 | 101.32 | 100.42 | 100.42 |
| 17 | 2 to 7 &13 | 5389.25 | 7596.25 | 5358.5 | 7687.9 | 99.43 | 101.21 | 100.31 | 100.32 |
| 18 | 2 to 7 &14 | 5418 | 7704.5 | 5352 | 7730 | 98.78 | 100.33 | 99.55 | 99.56 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 19 | 2 to 7 & 15 | 5349.7 | 7555.5 | 5315.8 | 7644 | 99.37 | 101.17 | 100.26 | 100.27 |
| 20 | 3-8 &10 | 5462 | 7885 | 5444 | 8070 | 99.67 | 102.35 | 101.00 | 101.01 |
| 21 | 3-8,11 | 5367.92 | 7590.44 | 5318.4 | 7667.8 | 99.08 | 101.02 | 100.04 | 100.05 |
| 22 | 3-8,12 | 5384 | 7640 | 5328 | 7720 | 98.96 | 101.05 | 100.00 | 100.00 |
| 23 | 3-8,13 | 5395.25 | 7636.75 | 5334.5 | 7707.9 | 98.87 | 100.93 | 99.90 | 99.90 |
| 24 | 3-8,14 | 5424 | 7745 | 5328 | 7750 | 98.23 | 100.06 | 99.14 | 99.15 |
| 25 | 3-8,15 | 5355.7 | 7596 | 5291.8 | 7664 | 98.81 | 100.90 | 99.85 | 99.85 |
| 26 | 4 to 10 | 5445.5 | 7746 | 5479 | 7900 | 100.62 | 101.99 | 101.30 | 101.30 |
| 27 | 4 to 9,11 | 5351.42 | 7451.44 | 5353.4 | 7497.8 | 100.04 | 100.62 | 100.33 | 100.33 |
| 28 | 4-9,12 | 5367.5 | 7501 | 5363 | 7550 | 99.92 | 100.65 | 100.28 | 100.28 |
| 29 | 4-9,13 | 5378.75 | 7497.75 | 5369.5 | 7537.9 | 99.83 | 100.54 | 100.18 | 100.18 |
| 30 | 4-9,14 | 5407.5 | 7606 | 5363 | 7580 | 99.18 | 99.66 | 99.42 | 99.42 |
| 31 | 4-9,15 | 5339.2 | 7457 | 5326.8 | 7494 | 99.77 | 100.50 | 100.13 | 100.13 |
| 32 | 5to 11 | 4679.42 | 6871.44 | 4529.4 | 6812.8 | 96.79 | 99.15 | 97.96 | 97.97 |
| 33 | 5-10,12 | 4695.5 | 6921 | 4539 | 6865 | 96.67 | 99.19 | 97.92 | 97.93 |
| 34 | 5-10,13 | 4706.75 | 6917.75 | 4545.5 | 6852.9 | 96.57 | 99.06 | 97.81 | 97.82 |
| 35 | 5-10,14 | 4735.5 | 7026 | 4539 | 6895 | 95.85 | 98.14 | 96.99 | 96.99 |
| 36 | 5-10,15 | 4667.2 | 6877 | 4502.8 | 6809 | 96.48 | 99.01 | 97.74 | 97.74 |
| 37 | 6 to12 | 3229.42 | 4946.44 | 3389.4 | 5302.8 | 104.95 | 107.20 | 106.07 | 106.08 |
| 38 | 6 to11and 13 | 3240.67 | 4943.19 | 3395.9 | 5290.7 | 104.79 | 107.03 | 105.90 | 105.91 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 39 | 6 to 11 ,14 | 3269.42 | 5051.44 | 3389.4 | 5332.8 | 103.67 | 105.57 | 104.62 | 104.62 |
| 40 | 6 to 11 ,15 | 3201.12 | 4902.44 | 3353.2 | 5246.8 | 104.75 | 107.02 | 105.88 | 105.89 |
| 41 | 7 to 13 | 2030.67 | 2618.19 | 1943.9 | 2500.7 | 95.73 | 95.51 | 95.62 | 95.62 |
| 42 | 7 To 12,14 | 2059.42 | 2726.44 | 1937.4 | 2542.8 | 94.08 | 93.26 | 93.67 | 93.67 |
| 43 | 7 To 12, 15 | 1991.12 | 2577.44 | 1901.2 | 2456.8 | 95.48 | 95.32 | 95.40 | 95.40 |
| 44 | 8 to 14 | 520.67 | 798.19 | 703.9 | 995.7 | 105.19 | 104.74 | 109.86 | 109.97 |
| 45 | 8 to 13,15 | 452.37 | 649.19 | 667.7 | 909.7 | 104.60 | 100.13 | 103.82 | 103.86 |
| 46 | 9 to 15 | 533.37 | 784.19 | 711.7 | 949.7 | 103.43 | 101.11 | 107.12 | 107.27 |
| 47 | 1 to 4 & 6 to 8 | 3877 | 5629.5 | 4188 | 6210 | 108.02 | 110.31 | 109.16 | 109.17 |
| 48 | 1 to 4 & 6,7,9 | 4016.5 | 5665.5 | 4447 | 6280 | 110.72 | 110.85 | 110.78 | 110.78 |
| 49 | 1 to 4 & 6,7,10 | 3996 | 5904.5 | 4348 | 6570 | 108.81 | 111.27 | 110.03 | 110.04 |
| 50 | 1 to 4 & 6,7 11 | 3901.92 | 5609.94 | 4222.4 | 6167.8 | 108.21 | 109.94 | 109.08 | 109.08 |
| 51 | 1 to 4 & 6,7,12 | 5458.2 | 7732 | 5486.8 | 7854 | 100.52 | 101.58 | 101.05 | 101.05 |
| 52 | 1 to 4 & 6,7,13 | 5436.5 | 7701 | 5463 | 7820 | 100.49 | 101.55 | 101.01 | 101.02 |
| 53 | 1 to 4 & 6,7,14 | 3958 | 5764.5 | 4232 | 6250 | 106.92 | 108.42 | 107.67 | 107.67 |
| 54 | 1 to 4 & 6,7,15 | 3889.7 | 5615.5 | 4195.8 | 6164 | 107.87 | 109.77 | 108.81 | 108.82 |
| 55 | 2-5, 7,8, 9 | 4580.92 | 6865.44 | 4314.4 | 6752.8 | 94.18 | 98.36 | 96.25 | 96.27 |
| 56 | 2-5, 7,8, 10 | 4592.17 | 6862.19 | 4320.9 | 6740.7 | 94.09 | 98.23 | 96.14 | 96.16 |
| 57 | 2-5, 7,8, 11 | 4620.92 | 6970.44 | 4314.4 | 6782.8 | 93.37 | 97.31 | 95.32 | 95.34 |
| 58 | 2-5, 7,8, 12 | 4552.62 | 6821.44 | 4278.2 | 6696.8 | 93.97 | 98.17 | 96.05 | 96.07 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59 | 2-5, 7,8, 13 | 4530.92 | 6790.44 | 4254.4 | 6662.8 | 93.90 | 98.12 | 95.99 | 96.01 |
| 60 | 2-5, 7,8, 14 | 4167 | 5349.5 | 3856 | 4930 | 92.54 | 92.16 | 92.35 | 92.35 |
| 61 | 2-5, 7,8, 15 | 4098.7 | 5200.5 | 3819.8 | 4844 | 93.20 | 93.14 | 93.17 | 93.17 |
| 62 | 3-6,8,9,10 | 3162.67 | 4698.19 | 3279.9 | 4940.7 | 103.71 | 105.16 | 104.43 | 104.43 |
| 63 | 3-6,8,9,11 | 3191.42 | 4806.44 | 3273.4 | 4982.8 | 102.57 | 103.67 | 103.12 | 103.12 |
| 64 | 3-6,8,9,12 | 3123.12 | 4657.44 | 3237.2 | 4896.8 | 103.65 | 105.14 | 104.39 | 104.40 |
| 65 | 3-6,8,9,13 | 3101.42 | 4626.44 | 3213.4 | 4862.8 | 103.61 | 105.11 | 104.36 | 104.36 |
| 66 | 3-6,8,9,14 | 3101.42 | 4626.44 | 3213.4 | 4862.8 | 103.61 | 105.11 | 104.36 | 104.36 |
| 67 | 3-6,8,9,15 | 3101.42 | 4626.44 | 3213.4 | 4862.8 | 103.61 | 105.11 | 104.36 | 104.36 |
| 68 | 3-6,9,10,11 | 3218.75 | 4852.75 | 3289.5 | 5022.9 | 102.20 | 103.51 | 102.85 | 102.85 |
| 69 | 3-6,9,10,12 | 3150.45 | 4703.75 | 3253.3 | 4936.9 | 103.26 | 104.96 | 104.11 | 104.11 |
| 70 | 3-6,9,10,13 | 3128.75 | 4672.75 | 3229.5 | 4902.9 | 103.22 | 104.93 | 104.07 | 104.07 |
| 71 | 3-6,9,10,14 | 3128.75 | 4672.75 | 3229.5 | 4902.9 | 103.22 | 104.93 | 104.07 | 104.07 |
| 72 | 3-6,9,10,15 | 3128.75 | 4672.75 | 3229.5 | 4902.9 | 103.22 | 104.93 | 104.07 | 104.07 |
| 73 | 3-6,10,11,12 | 3190.45 | 4808.75 | 3253.3 | 4966.9 | 101.97 | 103.29 | 102.63 | 102.63 |
| 74 | 3-6,10,11,13 | 3168.75 | 4777.75 | 3229.5 | 4932.9 | 101.92 | 103.25 | 102.58 | 102.58 |
| 75 | 3-6,10,11,14 | 3168.75 | 4777.75 | 3229.5 | 4932.9 | 101.92 | 103.25 | 102.58 | 102.58 |
| 76 | 3-6,10,11,15 | 3168.75 | 4777.75 | 3229.5 | 4932.9 | 101.92 | 103.25 | 102.58 | 102.58 |
| 77 | 3-6,8,10,11 | 3202.67 | 4803.19 | 3279.9 | 4970.7 | 102.41 | 103.49 | 102.95 | 102.95 |
| 78 | 3-6,8,10,12 | 3134.37 | 4654.19 | 3243.7 | 4884.7 | 103.49 | 104.95 | 104.22 | 104.22 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 79 | 3-6,8,10,13 | 3112.67 | 4623.19 | 3219.9 | 4850.7 | 103.44 | 104.92 | 104.18 | 104.18 |
| 80 | 3-6,8,10,14 | 3952 | 6065 | 4204 | 6565 | 106.38 | 108.24 | 107.31 | 107.31 |
| 81 | 3-6,8,10,15 | 3883.7 | 5916 | 4167.8 | 6479 | 107.32 | 109.52 | 108.41 | 108.42 |
| 82 | 4-7, 9,10,11 | 2086.75 | 2772.75 | 1953.5 | 2582.9 | 93.61 | 93.15 | 93.38 | 93.38 |
| 83 | 4-7, 9,10,12 | 2018.45 | 2623.75 | 1917.3 | 2496.9 | 94.99 | 95.17 | 95.08 | 95.08 |
| 84 | 4-7, 9,10,13 | 1996.75 | 2592.75 | 1893.5 | 2462.9 | 94.83 | 94.99 | 94.91 | 94.91 |
| 85 | 4-7, 9,10,14 | 5526.5 | 7881 | 5523 | 7940 | 99.94 | 100.75 | 100.34 | 100.34 |
| 86 | 4-7, 9,10,15 | 5458.2 | 7732 | 5486.8 | 7854 | 100.52 | 101.58 | 101.05 | 101.05 |
| 87 | 5-8,10,11,12 | 4580.92 | 6865.44 | 4314.4 | 6752.8 | 94.18 | 98.36 | 96.25 | 96.27 |
| 88 | 5-8,10,11,13 | 4592.17 | 6862.19 | 4320.9 | 6740.7 | 94.09 | 98.23 | 96.14 | 96.16 |
| 89 | 5-8,10,11,14 | 4620.92 | 6970.44 | 4314.4 | 6782.8 | 93.37 | 97.31 | 95.32 | 95.34 |
| 90 | 5-8,10,11,15 | 4552.62 | 6821.44 | 4278.2 | 6696.8 | 93.97 | 98.17 | 96.05 | 96.07 |
| 91 | 6-9,11,12,13 | 3162.67 | 4698.19 | 3279.9 | 4940.7 | 103.71 | 105.16 | 104.43 | 104.43 |
| 92 | 6-9,11,12,14 | 3191.42 | 4806.44 | 3273.4 | 4982.8 | 102.57 | 103.67 | 103.12 | 103.12 |
| 93 | 6-9,11,12,15 | 3123.12 | 4657.44 | 3237.2 | 4896.8 | 103.65 | 105.14 | 104.39 | 104.40 |
| 94 | 7-10,12,13,14 | 2086.75 | 2772.75 | 1953.5 | 2582.9 | 93.61 | 93.15 | 93.38 | 93.38 |
| 95 | 7-10,12,13,15 | 2018.45 | 2623.75 | 1917.3 | 2496.9 | 94.99 | 95.17 | 95.08 | 95.08 |
| 96 | 2,4,5,6,8,10,14 | 3790 | 5849.5 | 4004 | 6305 | 105.65 | 107.79 | 106.71 | 106.72 |
| 97 | 2,4,5,6,8,10,15 | 3721.7 | 5700.5 | 3967.8 | 6219 | 106.61 | 109.10 | 107.85 | 107.85 |

**Table 4.3: Frequency and probability Distribution of price Index numbers**

| S. N. | Class Interval | Mid Value | Frequencies | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Laspe-yre's | Prob.= (freq) / total freq. | Cum. Freq. | Paasche's | Prob.= (freq) / total freq. | Cum. Freq. | Fisher's | Prob. = (freq) / total freq. | Cum. Freq. | Dorbish & Bowley's | Prob.= (freq) / total freq. | Cum. Freq. |
| 1 | 90-92 | 91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 92-94 | 93 | 6 | 0.0619 | 0.0619 | 8 | 0.0825 | 0.0825 | 7 | 0.072 | 0.072 | 7 | 0.072 | 0.072 |
| 3 | 94-96 | 95 | 8 | 0.0825 | 0.1444 | 2 | 0.0206 | 0.1035 | 5 | 0.051 | 0.123 | 5 | 0.052 | 0.124 |
| 4 | 96-98 | 97 | 7 | 0.0722 | 0.2166 | 3 | 0.0309 | 0.1345 | 5 | 0.051 | 0.175 | 5 | 0.052 | 0.176 |
| 5 | 98-100 | 99 | 10 | 0.1031 | 0.3197 | 8 | 0.0825 | 0.217 | 6 | 0.061 | 0.237 | 6 | 0.062 | 0.238 |
| 6 | 100-102 | 101 | 16 | 0.1649 | 0.4847 | 16 | 0.1649 | 0.382 | 24 | 0.247 | 0.484 | 24 | 0.247 | 0.484 |
| 7 | 102-104 | 103 | 2 | 0.0206 | 0.5057 | 12 | 0.1237 | 0.506 | 3 | 0.030 | 0.515 | 3 | 0.031 | 0.515 |
| 8 | 104-106 | 105 | 7 | 0.0722 | 0.5779 | 3 | 0.0309 | 0.537 | 3 | 0.030 | 0.546 | 3 | 0.031 | 0.546 |
| 9 | 106-108 | 107 | 12 | 0.1237 | 0.7019 | 4 | 0.0412 | 0.5782 | 6 | 0.061 | 0.608 | 6 | 0.062 | 0.608 |
| 10 | 108-110 | 109 | 21 | 0.2165 | 0.9184 | 23 | 0.2371 | 0.8152 | 29 | 0.299 | 0.907 | 29 | 0.299 | 0.907 |
| 11 | 110-112 | 111 | 8 | 0.0825 | 1.0009 | 18 | 0.1856 | 1.0008 | 9 | 0.092 | 1 | 9 | 0.093 | 1 |
| 12 | 112-114 | 113 | 0 | 0 | 1.0009 | 0 | 0 | 1.0008 | 0 | 0 | 1 | 0 | 0.093 | 0 |

## 5.0 Sampling Distribution of Price Index Numbers:

Table 4.3 helps us in finding out values of moments, Skewness and Kurtosis as under;

## 5.1 Moments Skewness and Kurtosis of Index Number:

After calculating the values we calculate the values of moments about any point, central moments, Skewness and Kurtosis for different Index number as under:

### 5.1.1: For Laspayre's Index Number;

The moments about any points calculated with the help of table 4.3 for Laspayre's Index Number are as under;

$$\mu_1' = 2.144;\ \mu_2' = 36.29;\ \mu_3' = 169.89;\ \mu_4' = 1510.27.$$

The central moments, Skewness and Kurtosis for Laspayre's Index Number are

$$\mu_2 = 31.71;\quad \mu_3 = -43.50;\quad \mu_4 = 990.25.$$

$$\beta_1 = 0.0593;\quad \beta_2 = 0.985;\qquad \gamma_1 = 0.243;\qquad \gamma_2 = -2.015$$

### 5.1.2: For Paasche's Index Number;

The moments about any points calculated with the help of table 4.3 for Paasche's Index Number are as under;

$$\mu_1' = 3.28;\mu_2' = 43.09;\mu_3' = 269.44;\mu_4' = 3264.16$$

The central moments, Skewness and Kurtosis for Paasche's Index Number are

$$\mu_2 = 32.33;\mu_3 = -83.98;\mu_4 = 2163.35$$

$$\beta_1 = 0.2087;\quad \beta_2 = 2.0697;\qquad \gamma_1 = 0.457;\qquad \gamma_2 = -0.9303$$

### 5.1.3: For Fisher's Ideal Index Number;

The moments about any points calculated with the help of table 4.3 for Fisher's Ideal Index Number are as under;

$$\mu_1' = 2.66; \mu_2' = 38.80; \mu_3' = 209.57; \mu_4' = 2617.57$$

The central moments skewness and Kurtosis are

$$\mu_2 = 31.724; \mu_3 = -62.414; \mu_4 = 1884.48$$

$$\beta_1 = 0.0667; \quad \beta_2 = 1.872; \qquad \gamma_1 = 0.258; \qquad \gamma_2 = -1.127$$

### 5.1.4: For Dorbish & Bowley's Index Number;

The values of the parameters are same as we obtained the values of Fisher's Ideal Index Number. $\mu_1' = 2.66; \mu_2' = 38.80; \mu_3' = 209.57; \mu_4' = 2617.57$ are the moments about any point.

The central moment, skewness and kurtosis are

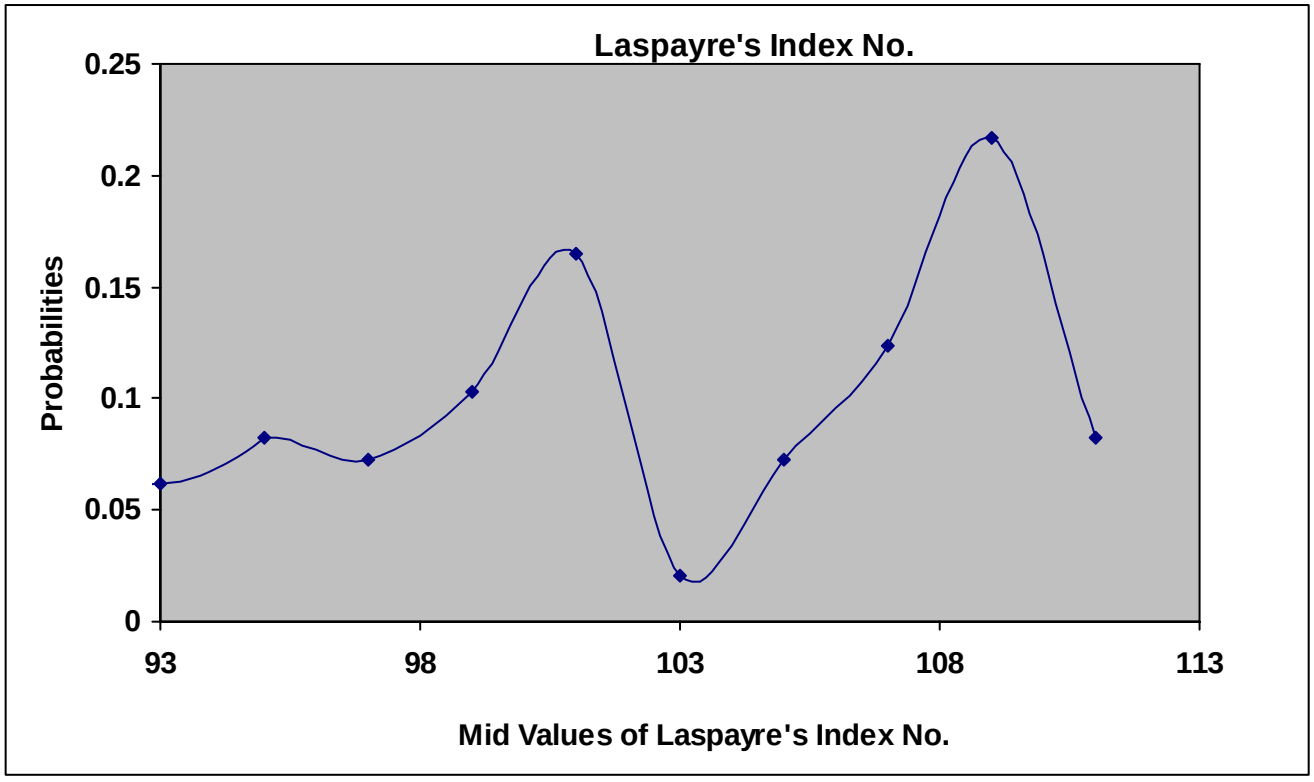
$$\mu_2 = 31.724; \mu_3 = -62.414; \mu_4 = 1884.48$$

$$\beta_1 = 0.0667; \quad \beta_2 = 1.872; \qquad \gamma_1 = 0.258; \qquad \gamma_2 = -1.127$$

**6.0 Chart drawn between the mid value and probabilities of the class intervals**

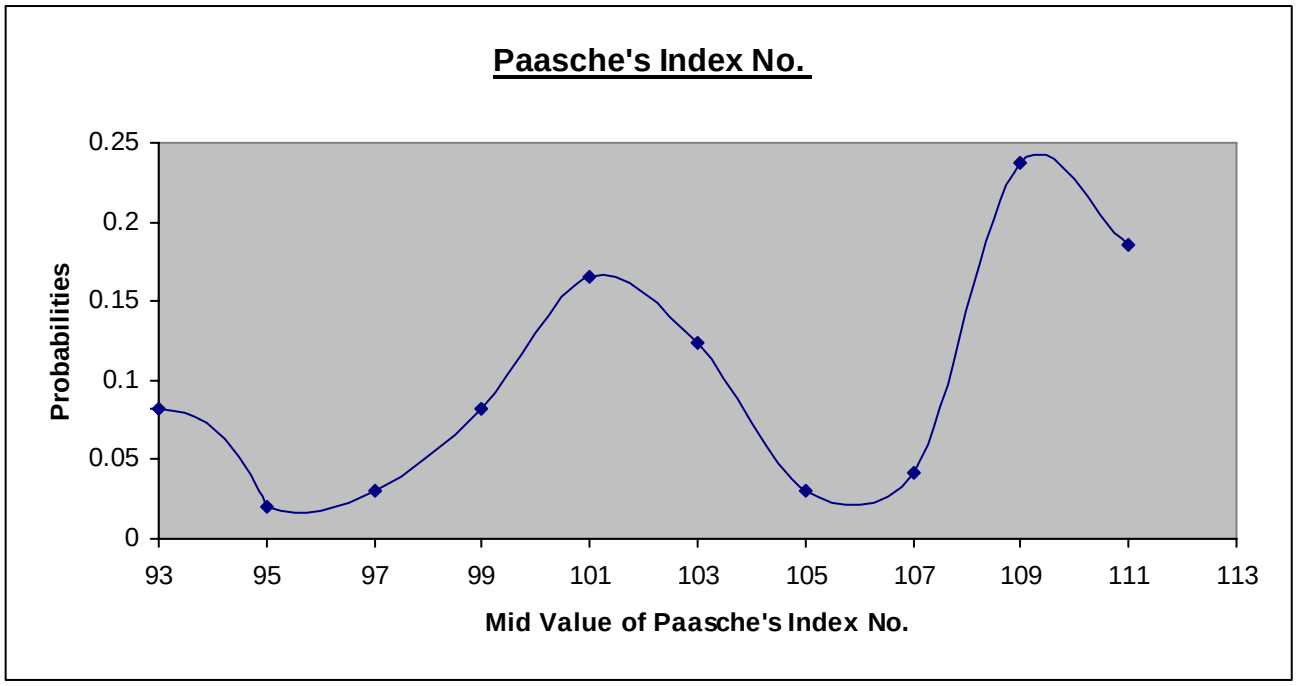
**6.1.1 Laspayre's Index Number**

| S.No. | Mid Value | Laspeyre's | Probability |
|---|---|---|---|
| 1 | 93 | 6 | 0.0619 |
| 2 | 95 | 8 | 0.0825 |
| 3 | 97 | 7 | 0.0722 |
| 4 | 99 | 10 | 0.1031 |
| 5 | 101 | 16 | 0.1649 |
| 6 | 103 | 2 | 0.0206 |
| 7 | 105 | 7 | 0.0722 |
| 8 | 107 | 12 | 0.1237 |
| 9 | 109 | 21 | 0.2165 |
| 10 | 111 | 8 | 0.0825 |



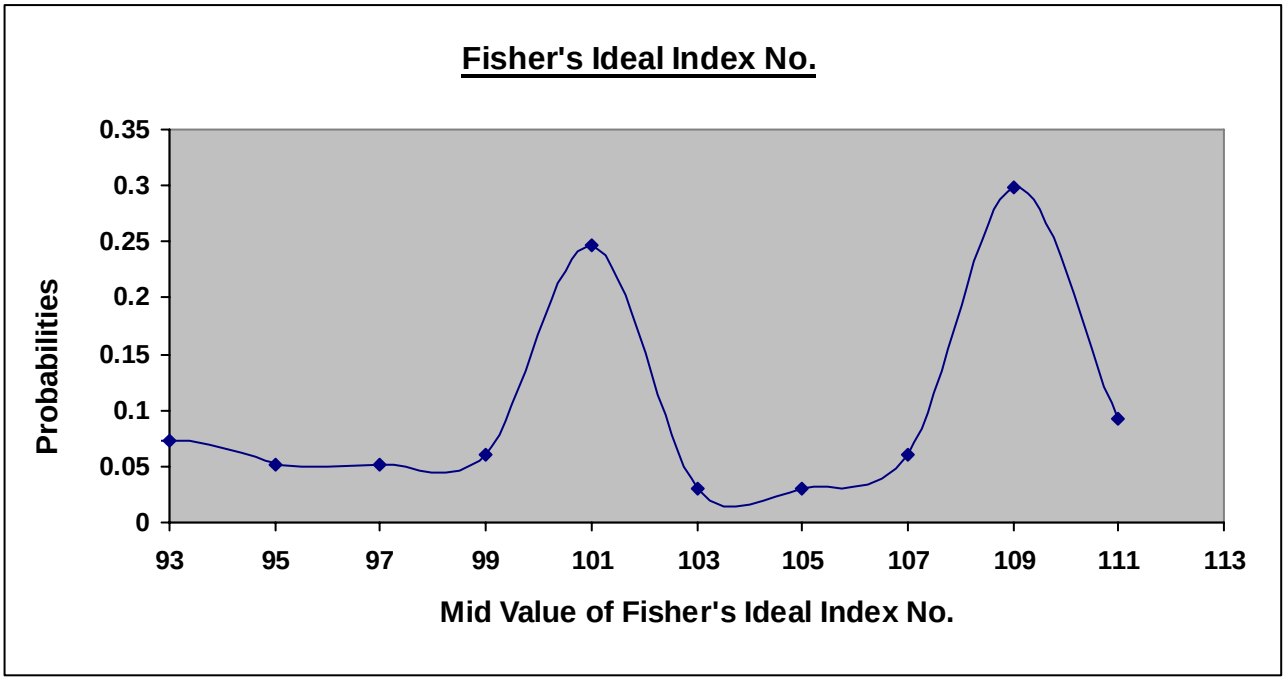
### 6.1.2 Paasche's Index Number

| S.No. | Mid Value | Paasche's | Probability |
|---|---|---|---|
| 1 | 93 | 8 | 0.0825 |
| 2 | 95 | 2 | 0.0206 |
| 3 | 97 | 3 | 0.0309 |
| 4 | 99 | 8 | 0.0825 |
| 5 | 101 | 16 | 0.1649 |
| 6 | 103 | 12 | 0.1237 |
| 7 | 105 | 3 | 0.0309 |
| 8 | 107 | 4 | 0.0412 |
| 9 | 109 | 23 | 0.2371 |
| 10 | 111 | 18 | 0.1856 |



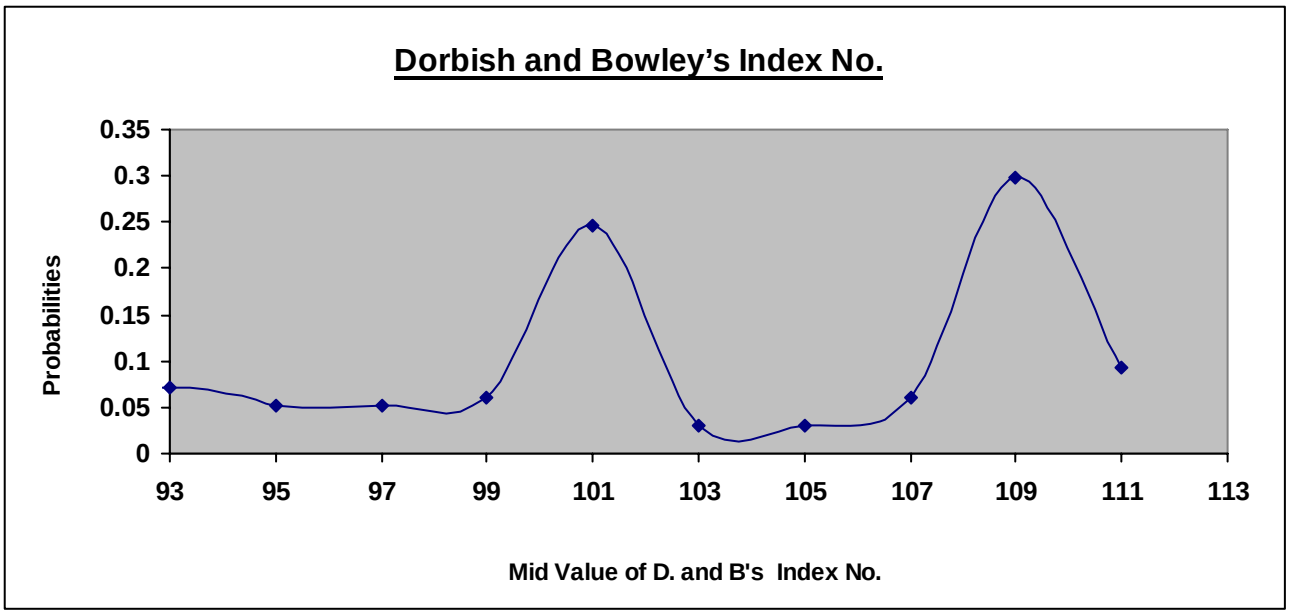
### 6.1.3 Fisher's Index Number

| S.No | Mid Value | Fisher's | Probability |
|---|---|---|---|
| 1 | 93 | 7 | 0.072 |
| 2 | 95 | 5 | 0.051 |
| 3 | 97 | 5 | 0.051 |
| 4 | 99 | 6 | 0.061 |
| 5 | 101 | 24 | 0.247 |
| 6 | 103 | 3 | 0.030 |
| 7 | 105 | 3 | 0.030 |
| 8 | 107 | 6 | 0.061 |
| 9 | 109 | 29 | 0.299 |
| 10 | 111 | 9 | 0.092 |



### 6.1.4 Dorbish and Bowley's Index Number

| S.No. | Mid Value | Dorbish Bowley's | Probability |
|---|---|---|---|
| 1 | 93 | 7 | 0.072 |
| 2 | 95 | 5 | 0.051 |
| 3 | 97 | 5 | 0.051 |
| 4 | 99 | 6 | 0.061 |
| 5 | 101 | 24 | 0.247 |
| 6 | 103 | 3 | 0.030 |
| 7 | 105 | 3 | 0.030 |
| 8 | 107 | 6 | 0.061 |
| 9 | 109 | 29 | 0.299 |
| 10 | 111 | 9 | 0.092 |



## 7.0 Concluding Remark:

With the help of table given in section 4.3 the moment about any point, central moments, skewness and kurtosis are calculated. The mean of Laspayre's Index number is 2.144 and variance is 31.71 whereas in Paasche's Index number the average value comes to 3.28 and variance is 32.33. The Fisher's Ideal Index number and Dorbish and Bowley's Index number gives the value of mean equal to 2.66 with the variability of 31.724. From the figure obtained we can conclude that the variability in Laspayre's Index number is minimum as compared to other Index number and is supposed to be more consistent. And the mean value of Paasche's Index number is more than the other Index number under consideration.

The value of skewness of all the Index number is calculated which provides the lack of symmetry in the curve and the nature of the curve is negatively skewed. The same thing was observed in the kurtosis and result into platy-kurtic giving value less than 3.

The numerical illustration is also supported by finding out the probabilities and with the curve drawn between the mid value of the class interval and probabilities. The explanation is discussed in section 5.0.

By observing the solution of the problem one can opt any Index number among the Fisher's Ideal Index number and Dorbish and Bowley's Index number because both provides the same values for the parameter.

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